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THE ROLE OF THE FOREST PRODUCTS INDUSTRY IN ECONOMIC DEVELOPMENT

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THE ROLE OF THE FOREST PRODUCTS INDUSTRY IN ECONOMIC DEVELOPMENT

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1. The occurrence of forest cover of some kind is almost universal. It is now recognized that the precise species available is not of major importance. Because of the great variety of possible products and the wide choice of process steps, almost any species can be put to profitable use.

2. There are some who fear that the use of wood is declining and that it may come to an ignominious end in the not distant future. What they are really thinking about are some contemporary products made of wood, not wood itself. Some products decline, others taking their places, grow. But the commodity, wood, is used in ever increasing volume. There is no evidence to support the fear that wood use will decline.

3. The tree farm concept of sustained yield and crop harvest in perpetuity rescued the forest products industry from an existence strongly flavored with expediency, and gave it instead long-range planning, orderly development, and a favorable climate for investment.

4. The objective of this presentation is to make clear and convincing the unique contribution which any forest can make to the economic development of a community, large or small, and to define certain guidelines which are essential to the success of this development, particularly in the area of complete and integrated utilization of the forest crop.

Multiple Uses of Forest Products

5. The most important broad uses that are made of manufactured forest products are in:

(a) Serving construction, both structural, functional, and decorative.
(b) Serving transportation, from the irreplaceable railroad tie at one extreme to the decking of ships at the other.
(c) Providing the necessities of living: the millwork, the cabinets, the counters, the wardrobes, the closets, and so on.
(d) Providing the comforts of living: the paneling, the furniture, the flooring, the insulation, the sound deadening, and so on.
(e) Serving communication: the spoken, written, and printed word.
(f) Providing shipping containers and their accessories of all kinds from the little egg carton of perfect performance to the huge modular transferable crates or bins.
(g) Providing the pleasures of living from the gun stock of the sportsman to the grand piano of the artist.
(h) Providing the paper products for healthful living, and
(i) Contributing to the great areas of films, filaments, textiles, finishes, explosives, soil mulches, concrete additives, well drilling aids, adhesive extenders and others.

Diversity of the Forest Products Industry

6. Only when one attempts to list all the markets for and the uses made of forest products, does one realize how greatly diversified the industry is. This diversity, however, can be broken down into three major categories of forest products: solid wood, fibers, and chemicals.

7. Solid wood takes many forms: Round piles, poles, and posts; sawed lumber of many varieties; sawed timbers larger and heavier than lumber; millwork engineered to specific uses; laminated lumber as structural members; plywood serving an entire panel-using world of its own; sawed or split shingles and shakes; and finally sub-divided whole wood running the gamut from wood wool through shavings and flakes to sawdust and wood flour.

8. Fibers, from whole wood to all-cellulose, also take many forms, their variety being such as to force one to be arbitrary in attempting any all-inclusive classification. Wood fibers cannot be prevented from felting and their great utility depends upon this felting action. Among these fiber products now on the market, exclusive of paper or paperboard, are low density mats and blankets for packing, padding, deadening sound and restricting heat transmission; insulation boards providing decorative and acoustical ceilings; sheathing, roof decking, and sidings; and finally hardboard, which is currently undergoing a change from commodity to engineered product reaching for additional markets through improved hardness, smoothness, durability, and visual appeal.

9. With respect to the ramifications of paper and paperboard, the differentiation between the two is largely a matter of thickness. The variety of materials used runs the full range from reclaimed waste paper through mechanical pulps or groundwoods, high-yield chemical pulps to full chemical pulps unbleached, bleached and purified. There are papers well standardized in appearance and performance, e.g., newsprint containing a high percentage of mechanical pulp, and such strong all-chemical pulp papers as kraft liner, kraft bag, and kraft wrapper. Huge investments are required for this aspect of the paper industry since these products serve big tonnage uses and their producing mills are large and of high cost per daily ton of capacity.

10. The more than a million tons of chemical cellulose produced annually for conversion to filaments, films, lacquers, and explosives is the outstanding commercial accomplishment in chemicals from wood. Although this is over-simplification, we may take wood apart gently, or we may break it up by rough treatment into chemical pieces. Broadly we may attempt this in four different ways: The first is fractionation or extraction, an ideal method to employ in which the severity of treatment is kept to the minimum required to accomplish the separations. The second may be called cleavage, whereby the lignin is rendered soluble by delignification, leaving the cellulose insoluble; or the cellulose is made soluble by conversion to sugars by hydrolysis, leaving the lignin insoluble. The third approach makes almost everything soluble by hydrogenation. The fourth approach produces a mixture of solids, liquids and gases by pyrolysis. All four of these techniques continue under development in the U.S. and no doubt in other countries also.

11. Sound economics require that chemical use be centered in conversion of all of a given raw material into valuable products. Those who continue to discard a substantial portion of their raw material as waste are not showing sound judgment.

Establishment of a Forest Products Industry

12. In planning for the establishment of a forest products industry there are a

number of factors that need to be taken into consideration. First consideration should be given to the possible markets for the products, the availability of raw materials, and the requirements of use. If these appear favorable, then consideration should be given to such matters as practical technology, sound economics, capital, right timing, and provisions for renewing the forest resource.

13. Any specific business originates in the markets and the uses it serves. These govern the nature of its products, the products in turn control their production, and the process steps and corresponding equipment are chosen to convert economically the available raw material to the product desired. Hence, choice of market, uses and products come first; second is choice of raw material, depending on the forest inventory, sustained yield and delivered cost species by species; third, choice of the process steps to connect the raw material to the product; and fourth, the choice of equipment to execute the process steps.

14. The choice of the raw materials to be used depends to a great extent on taking advantage of unique superiorities exhibited by some one of the species, both product- and process-wise. The scope of practical technology encompasses both the process steps and the equipment to carry them out.

15. Both industry and government have paid much too little attention to the requirements of use. The requirements of use control the property values of the product; they control its satisfactory performance in use, and thereby its price level, both absolute and relative to competition; and finally its very business existence. Therefore, before we plunge into commercialization, the facts of performance must be developed. These are some suggested steps:

(a) Record the use requirements involved in ordinary nontechnical terms. This describes what the product must do.
(b) Select the corresponding product properties.
(c) Establish adequate methods of test for each property.
(d) Prepare an ideal specification.
(e) Modify the ideal to a technically and economically practical specification.
(f) Measure product performance. This describes what the product must be.

16. We therefore observe that there are two performance yardsticks -- one absolute based on use, the other relative based on competition. The foregoing sequence is called the use requirements technique, and before it is attempted a thorough market survey should be made.

17. The technology to be practical must either have been practiced elsewhere or have gone through pilot plant studies successfully. . It must not be too complicated, yet adequate for the job to be done. It should provide ease of control. It should lend itself to the application of continuity of manufacture, and should be amenable to developing manufacturing costs which allow production to reach its profit objective.

18. The most often encountered stumbling block to successful commercialization is that of sound economics. One cannot help but marvel at the number of projects going into commercialization without any serious attempt at an operating forecast. This forecast merely determines net earnings after taxes by subtracting all expense from net sales income in as simple and logical a manner as possible.

19. A definition of sound economics in this instance might include the following: Enough volume of goods bringing a sufficient price in the competitive market place;

to furnish a profitable income; to provide workers with the necessities and some of the luxuries of living; to pay direct and indirect manufacturing costs, including those for replacement of equipment priced at more than the depreciation reserve; to provide for normal company growth; and to finance a fair share of governmental functions while still maintaining enough earnings to pay as much for use of the funds invested in the enterprise as could be obtained otherwise on an equal risk basis.

20. In connection with the capital requirements per unit of production capacity, there is great leeway in the case of wood to choose the extent to which the traditional simplicity of process steps and equipment shall be enjoyed as compared with the more complicated contemporary techniques.

21. Right timing is often overlooked. It is a hard lesson to learn. Regardless of how attractive the market may be, how practical the technology, or how sound the economics are, there must be good justification for attempting commercialization -- justification which has its genesis usually in a real need. One often hears of the inventor who was ahead of his time. His timing was wrong. The semichemical pulping process went into the first pulp mill about 1930. The process slept peacefully until 1945 when it was suddenly awakened owing to the realization that it would permit cheaper species to be used for pulp and paper. Advent of the compression barker was inadvertently timed perfectly, since a great need existed for a barker of low capital and operating cost.

The Tree Farm Program

22. The fact that forests are a renewable resource should be recognized, of course, in planning for a forest products industry, and the whole program should be structured on this important asset.

23. It has now been recognized that forest cover is not an inexhaustible resource and that nature alone cannot be expected to replace the timber that man has harvested. Nature can supply the seeds but unfortunately, as in the case of the conifers, rodents find these very tasty, and when the relatively small number of seeds that survive produce seedlings the ruminants come in to feast on the succulent plants. Electrical and wind storms, likewise, take their toll. Thus, man's help is needed.

24. The tree farm concept came into being as a means of helping nature replace the trees that are harvested or destroyed, and thereby insuring an adequate future supply of lumber. Basically, it involves a series of measures which when properly applied provide the reforestation required. One of such measures is to coat the tree seeds with a repellant that is distasteful to rodents. The coated seeds are then spread over a denuded area by helicopter. Another is to establish large tree nurseries to grow seedlings for transplanting. Different practices are followed for the various species. In the case of ponderosa pine, for example, the modern practice is to harvest the tree crop by a thinning out process and then to replace the cut trees with seedlings. The result is a whole forest of trees at various stages of growth. The douglas fir seedling, on the other hand, is not able to survive under such conditions since it does not thrive in the shade, and the accepted practice, therefore, is to completely clear the various plots where the trees have reached maturity, and then spread seeds over the area by helicopter, or transplant seedlings. In any case, the young seedlings require careful attention so that those damaged by ruminants, or by other means, can be replaced. Also, the whole forest area must be inspected periodically for diseased trees and these should be promptly removed to avoid having the disease spread and ruin the forest.

Integrated Utilization of the Forest Crop

25. If we are to enjoy the unique opportunity wood gives us to benefit by integration, then we should plan against a background of complete utilization of the tree farm crop. This in turn means building an industrial complex, gradually certainly, starting modestly, and proceeding soundly as the integration expands.

26. In forest products, our first concern is to utilize the whole log and when this has been accomplished, then the whole tree harvest and finally the whole tree farm crop. Common sense tells us to give highest priority to the integrated utilization of the whole log as brought to the mill.

27. It is axiomatic that whole log use can be successful only to the extent that markets and uses consume huge quantities of products. That any such markets could be found for mixtures of such different materials as wood and bark is certainly remote. Then, regardless of the ultimate products, these two constituents must be cleanly separated, wasting neither one. Until 1950, saw log users had been unconcerned about the barking process; plywood producers chewed the bark off of their so-called peeler blocks along with a substantial percentage of clear sapwood.

28. The pulp makers for years had accomplished their barking of small logs by manual woods peeling or by the use of huge drums at the mill. Later they employed hydraulic barkers for both small and large logs giving bark-free wood, but not wood-free bark. These hydraulic barkers were so expensive in first cost and operating cost that their use in any but the largest operations could not be justified. This was the situation which demanded an answer, especially one within the ability of the small operator to finance. A number of approaches to an answer to this question have been attempted in the last decade, and the answer now seems definitely in hand, namely, continuous mechanical barking at the mill.

29. Sparked by the desire to achieve bark-free logs and in turn, if possible, convert wood-free bark by a dry process to useful products, the Weyerhaeuser Company began to explore the possibilities of dry log barking in 1945, at that time for application to peeler logs. The first barker of this type was put into successful operation in in 1947 in the then new plywood plant of Weyerhaeuser and furnished "as is" bark to a new bark utilization plant which went into operation that same year. Since that time this basic principle of compression and shearing at the cambium layer has been employed in many designs of log barkers, with a cost well within the resources of the smaller log processors. This technique of compression barking is probably the greatest factor in accelerating integrated whole log use in the U.S.

30. Now, assuming we have bark-free wood in log form ready for processing, what key product will do most to reach whole log utilization? Since the manufacture of fiber or chemicals starts with wood in relatively small pieces, it would appear logical that solid wood products of substantial dimensions should be our first choice. This means, of course, lumber and plywood. Will lumber manufacture be a sufficiently stable and profitable business to justify the close relationship that is involved in future raw material integration?

31. The storage and handling of huge tonnages of raw material are economically accomplished even with species whose logs do not float. Fifty tons of coniferous wood is fed to the mill per hour, or a ton a minute, for the sawing of 100,000 FLS in eight hours. The reduction of the log to lumber is continuous, processing temperatures and pressures are atmospheric, no other raw materials of any consequence are required, the equipment is reliable, the performance dependable and reproducible. Labor and plant investment per unit of output are low and annual net income per capital dollar invested is attractive. These are the details which provide a stable successful basis for integration.

32. The manufacture of lumber and plywood has a unique opportunity to bring raw material integration into being. Certain it is that no cheaper hardboard, softboard, particleboard, or pulp or paper can be made than that provided by integration with the manufacture of lumber and plywood. It is believed that these solid wood products constitute the best foundation for whole log use.

33. Integration other than that of raw material depends on the details of the specific case so far as process steps and supporting equipment type and arrangement are concerned. The harvesting of marginal logs and their transportation require little change in techniques. Chipping, flaking, and screening operations are new, but the handling of masses of bulk materials is old. The servicing of the integrated operation, both from the standpoint of producing and distributing the utilities, and supplying all the administrative functions, involves merely enlarging the staff and facilities, with the opportunity to improve performance by so doing.

34. Our discussion thus far has been limited, at least by inference, to mill residuals of chippable shape and size. There are, however, many other kinds of residuals. The following listing includes all types commonly encountered:

(a) Mill Residuals - Concentrated at the mill

Lumber

Bark; chippable - slabs, edgings and trim; shavings - green and dry; and sawdust - green and dry

Plywood

"Lily pads"; bark; cores; broken and discarded veneer - green and dry; panel trim; and sander flour

(b) Logging Residuals - On the ground

Tops; branches; chunks, - large diameter short length pieces; toothpicks, - small diameter shatter and knocked down saplings; and marginal logs, - crook, decay, shake and so on from felled merchantable trees, sometimes called "wood logs"

(c) Forest Residuals - Standing

Cull trees, producing "cull logs" if felled - those of poor form and large defects; small trees, including thinnings; unwanted or unpopular species; and inaccessible trees, too costly to secure.

35. The chippable residuals have as chips many uses in the fiber field, which is well understood and widely practiced in the United States. The shavings find their outlet primarily in particleboard, although some go along with the chips. We now find it convenient to differentiate between coarse and fine sawdust, the former being usable to a modest extent in certain fibrous products. Tonnage use of fine sawdust is still a problem with the answer probably to be found in chemicals manufacture. Bark is being converted in many ways to usable commodities through both mechanical and chemical processing. Ten percent of the incoming logs cannot be wasted indefinitely, especially in view of the unique constituents it contains. In the plywood picture, lily pads, cores and discarded veneer are chippable residuals. Volume uses for sander flour are still to be found.

36. As the mill residuals earn a profit, the easiest-to-get logging residuals begin to come in with the good logs and, since these do not appear in any timber cruise, they cost only what it takes to bring them in. It is clear that the cost increases as the pieces are smaller, shorter, and farther away. So the complete integrated utilization which we seek depends not only on efficient conversion and marketing, but on less costly techniques of harvesting and transportation. As an example of the advantages of integrated use, the yield per acre from an old but

heavy stand of douglas fir was increased over a period of some fifteen years from about 40,000 feet log scale to 80,000.

Typical Commercial Integrations

37. A listing of some of the commonly practiced simple integrations is as follows:

(a) Softwood lumber production with the production of industrial wood parts, glued-up panels, prefabricated timber members, laminated structural members ("glu-lam"), chips, veneer, plywood, softboard, hardboard, particleboard, and various pulps

(b) Plywood production with production of industrial wood parts, prefabricated panels and structural members, chips, softboard, hardboard, various pulps, paper overlays, and hardboard overlays

(c) Softboard, hardboard production with hardboard overlays, paper overlays; and particleboard production with veneer overlays and paper overlays

38. A listing of some of the unusual integrations is as follows:

(a) Lumber production with the production of whole wood fiber, wet pulp molding, bark products, and carbohydrate gum

(b) Plywood production with the production of bark products, paper overlaid veneer - (2 faces), and facings of pulp

(c) Particleboard with facings of pulp

39. There are many complex integrations in the largest operations in the United States, one of which for example, based on lumber and plywood, includes lumber panelization, glue laminated members, prefabricated timber members, bark products both mechanical and chemical, sulfite, semichemical and sulfate pulps, and various grades of paper from food board to glassine.

Smallest Practical Manufacturing Capabilities for Various Forest Products

40. Approximate guidelines frequently asked for by those contemplating entering some phase of the forest products industry, usually as part of an integration are: What is the smallest practical manufacturing capacity, and what is the fixed capital investment likely to be?

41. The principal problem, even in generalizing, is to rationalize the wide differences in prices, costs, climate, availability of services, site quality, product variety, and extent of finishing operations. There are a number of well-known factors which put a ceiling on plant size. There are also others which are used to determine the minimum size, e.g. to avoid unsound economics, a size too small to integrate or a size controlled by the maximum operating capacity of a key piece of equipment.

42. It is customary in the United States to express plant capacities in short air-dried tons per day, and capital cost in dollars per daily short ton, because of the variety of units of measurement of production encountered with different products. The following table is self-explanatory:

Table 1

1 Product	2 Minimum Daily Production Capacity	3 Expressed in Units thus	4 Days per Operating Year	5 Shifts per Operating Day	6 Capacity Limited by	7 Factor to Convert 2 to short air dry tons	8 Minimum Daily Production Capacity tons*	9 Basic Fixed Investment dollars per short ton
Structural Plywood	220,00	Sq. ft. 3/8"- 30 lbs. pcf.	240	2	1 Hot Press	.00047	100	35,000
Softboard	330,000	Sq. ft ½" 20 lbs. pcf.	340	3	1 Wet Forming Machine	.00042	140	45,000
Hardboard	275,000	Sq. ft. 1/8" 64 lbs. pcf.	340	3	1 Dry Forming Machine	.00033	90	35,000
Particle-board	45,000	Sq. ft. 3/4" 40 lbs. pcf.	240	3	1 Single Opening Press 8'x16'	.00125	50	20,000
Semi-Chemical Pulp	100	Short AD tons	340	3	Defiber-ing and economics	1.00	100	25,000
Unbleached Kraft Pulp and Paper	200	Short AD tons	340	3	Economics	1.00	200	30,000

43. Lumber is omitted from the above tabulation because of the terrific variety of mill designs and sizes extending from as little as one million feet board measure (FBM) annually to as much as 200,000,000 in certain places on the West Coast of the U.S. The principle matter of interest here is the minimum size finished kiln dry lumber-mill to support integrated utilization. We may assume roughly that half of the actual volume of solid wood going into such a mill turns up as residuals and half of these are suitable for chips or flakes. One thousand FBM of U.S. West Coast douglas fir lumber shows an actual volume of about 70 cubic feet. This, at thirty pounds per cubic foot, is equal roughly to a ton of wood. Hence for every two tons dry going into the mill, one-half ton turns up as chips or flakes.

44. To tie the figures of Table 1 into the required size of a lumber or plywood mill to be the sole source of useable residuals requires knowledge of such details as usage of nonchippable residuals as well as chips for raw material; the actual distribution of incoming wood and most important weight yields from residual to finished integrated product; and days per year the mill is operated.

45. It should be emphasized that all the foregoing figures are for the purpose of initial project orientation and it is hoped they will be useful in crystallizing a course of action. They must not be used to arrive at firm and final decisions without adequate confirmation. Also, all the figures apply to the North American conifers.

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* Figures rounded off.

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